Self Optimization Perspective of Link Adaptation in Cellular Networks

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***Abstract*—**In this paper the focus is given on self configuration from the automatic link Adaptation cycle perspective. First dependence of link adaptation cycle on scenario parameters carrier frequency and Doppler shifts have been shown. Automatic configuration of link adaptation cycle has been analyzed. Optimized link adaptation cycle chosen leads to better performance of the system in terms of system capacity and area spectral efficiency.

Keywords—LTE; self configuration ; automatic link adaptation, Plug and Play nodes; Frequency Synchronization; Fading; BER;

I. INTRODUCTION

Aiming towards Long Term Evolution, 3GPP has proposed SON (Self Organizing Network) in order to deal with growing complexity in cellular networks. SON deals with self configuration, self optimization and self healing, thereby making installation and management all automatic, leading to saving in CAPEX (Capital Expenditure) and OPEX(Operational Expenditure). As 4G (LTE) and beyond networks supports introduction of femtos, micro cells and relay nodes for reducing the coverage holes and enhancing network density and overall system capacity, the introduction of these cells and nodes have made network planning and management complex and tedious. These tedious task of initial installation and maintenance can be made automatic using self configuration, self optimization and self healing, without or with less manual requirements. Thus, Self Configuration enables the introduction of BSs/nodes simply “Plug and Play”, with build up procedure and initial configuration automatic with less or no manual intervention.

Self configuration deals with automating the configuration task in the build up phase and maintain phase [1]. Self booting mechanism for newly added eNBs without back-haul have been dealt by authors in [2]. The authors in [3] have developed framework and algorithms for self configuration of antenna tilt and transmission power for eNBs. SON optimization of coverage and capacity using automatic adjustment of antenna tilt has been dealt by authors in [4]. Automated configuration i.e self configuration in establishing initial Operation, Administration and Maintenance (OAM) in Relay node deployment and transition from configuration to operational phase been dealt by authors in [5].

II. PROBLEM DOMAIN

Rayleigh fading are changing in nature. If UE changes its location away from the previous location and the same cutoff snrs are chosen then BER target won’t get satisfied and there would be fall in spectral efficiency. If UE changes its location near to eNB from the previous location and the same cutoff snrs are chosen there would be fall in spectral efficiency as we are under-utilizing the AMC. This means that LUT(Look up Table) for cutoff snrs also has to be adapted along with AMC in order to achieve the best possible spectral efficiency simultaneously maintaining QoS.

Femto or micro cells or relay nodes have different power delay profile as compared Macro cell, when these new eNBs are introduced appropriate Link Adaptation Cycle needs to be opted best suiting the power delay profile of the new cell or node, which itself depends on transmitter power,frequency of operation and velocity supported. If Link adaptation cycle not chosen appropriately may lead to either underutilization of resource or may lead to deterioration in QoS. To facilitate the automatic adaptation in Link Adaptation Cycle/Automatic CQI Feedback under introduction of femto or new nodes as well during operation.

III. SIMULATION PARAMETERS

TABLE I
SYSTEM PARAMETERS

Parameters	Scenario1	scenario2
	Urban Micro	Urban Macro
Transmit Power	41dBm	46dBm
Intersite Distance	200metres	500metres
Carrier Frequency	2.5GHz	2GHz

IV. OBSERVATION AND RESULTS

The plots are work on Automatic Link Adaptation perspective of Self Configuration which shows that Link Adaptation Cycle needs to be configured/adapted with the changing scenarios as the power delay profile depends on the transmitter power, frequency of operation and velocity supported by eNBs. In the initial work I have taken effect of velocity which is governed by $f_d = v_c f_c$.

Figures 1 and 2 respectively tells two different scenarios. In the simulation Urban Micro and Urban Macro have been taken.

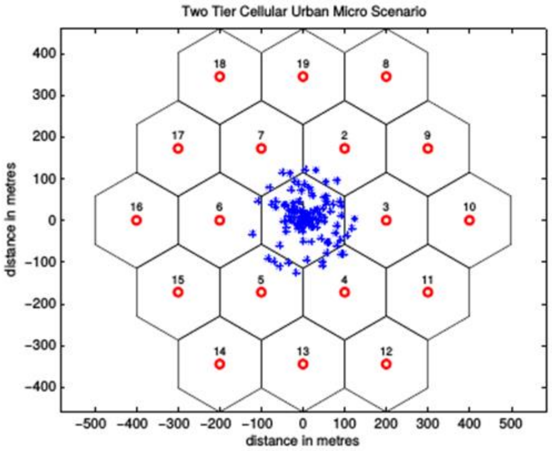

Figure 1

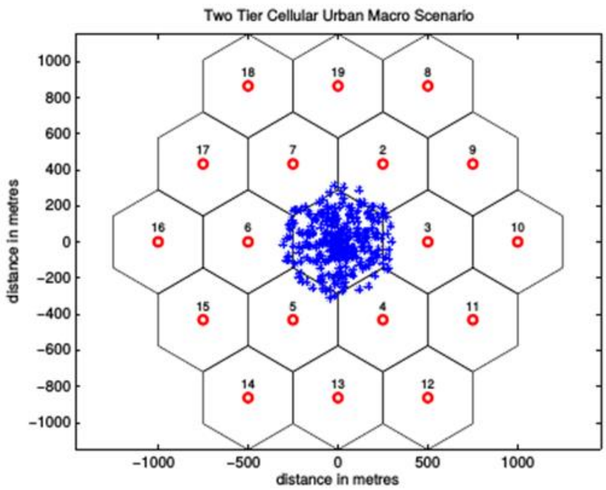

Figure 2

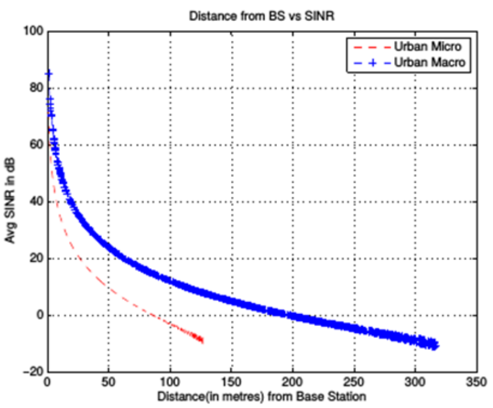

Figure 3

Figure 3 indicates the observed SINR with respect to distance from eNB for Urban Micro and Urban Macro scenarios respectively.

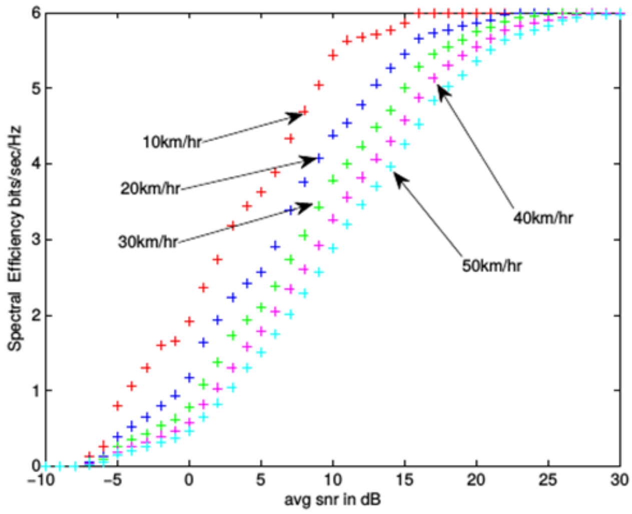

Fig. 4. Effect of velocity of user on spectral efficiency

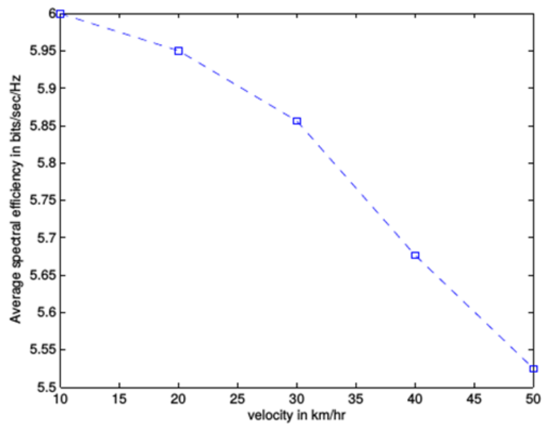

Fig. 5. Effect of velocity of user on average spectral efficiency

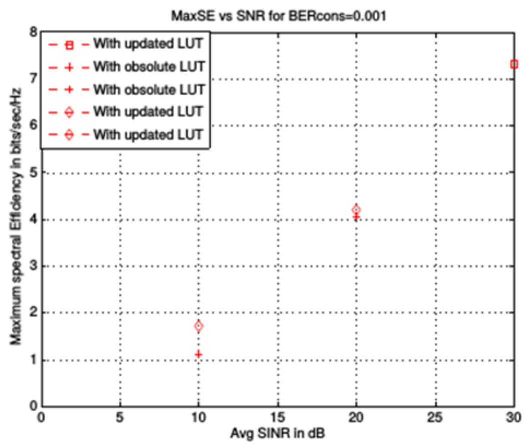

Fig. 6. Effect on updating LUT on spectral efficiency

The figure 6 shows about the variance in max spectral efficiency with updated LUT as compared to un-updated. It has been observed that there is improvement in max spectral efficiency with updated LUT and the effect becomes predominant with the difference in average SINR. An improvement of 0.5970bits/sec/Hz is being observed at average SINR of 10dB with updated LUT as compared with the reference LUT is one that is being used at average

SINR 30dB.The updated LUT would be surely beneficial for edge users where the spectral efficiency is poor. Updated LUT may increase spectral efficiency by an appreciable good amount.

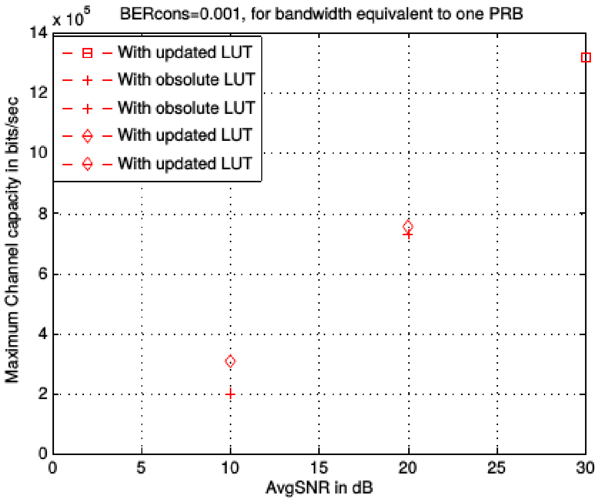

Fig. 7. Effect on updating LUT on spectral efficiency for one PRB

Figure 7 shows that if channel bandwidth equivalent to one PRB ie. 180 KHz and if the same reference LUT is being used an improvement of 100kbps for the users having average SINR 10dB has been observed in figure5.

VI. CONCLUSIONS

The AMC gives the maximum possible spectral efficiency along with satisfying BER and Power constraints with the updated LUT. With obsolute LUT and more conservative AMC have the degraded performance in terms of spectral efficiency whereas more aggressive AMC have better spectral efficiency but at the stake of degraded BER performance. LUT can be updated through CQI learning.

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